Density	Data	Total
<=5	Sum of # Households	62,645
	Average of Loop Length	81,872.32
	Average of Loop $ per HH	4,303.10
	Average of Total Invstmnt/Ln	4,966.35
>2550	Sum of # Households	364,583
	Average of Loop Length	8,070.19
	Average of Loop $ per HH	198.98
	Average of Total Invstmnt/Ln	459.98
200 to 650	Sum of # Households	273,086
	Average of Loop Length	15,153.19
	Average of Loop $ per HH	356.31
	Average of Total Invstmnt/Ln	643.22
5 TO 200	Sum of # Households	372,988
	Average of Loop Length	28,234.15
	Average of Loop $ per HH	866.56
	Average of Total Invstmnt/Ln	1,219.02
650 to 850	Sum of # Households	109,294
	Average of Loop Length	12,680.94
	Average of Loop $ per HH	293.74
	Average of Total Invstmnt/Ln	564.94
850 to 2550	Sum of # Households	689,169
	Average of Loop Length	11,045.12
	Average of Loop $ per HH	294.19
	Average of Total Invstmnt/Ln	560.32

Density	Data	Total
<=5	Average of Monthly Cost1	131.10
	Average of Monthly Cost2	95.06
>2550	Average of Monthly Cost1	12.14
	Average of Monthly Cost2	8.80
200 to 650	Average of Monthly Cost1	16.98
	Average of Monthly Cost2	12.31
5 TO 200	Average of Monthly Cost1	32.18
	Average of Monthly Cost2	23.33
650 to 850	Average of Monthly Cost1	14.91
	Average of Monthly Cost2	10.81
850 to 2550	Average of Monthly Cost1	14.79
	Average of Monthly Cost2	10.73

	ARMIS	DIRECT
Aggregate Support at $20=	$ 89,225,208	$ 38,486,149
Aggregate Support at $30=	$ 47,456,378	$ 22,756,400
Aggregate Support at $40=	$ 32,830,891	$ 14,653,261
Annual Benchmark Cost =	$ 445,164,744	$ 322,808,207
State Average Monthly Cost=	$ 19.82	$ 14.37

Note: Results for WA State with BCM distribution cable multipliers moderately adjusted for the following CBGs:
1) Distribution cable multiplier multiplied by 10 for CBGs with household density less than 200 and number of households less than 200.
2) Distribution cable multiplier multiplied by 3 for CBGs with household density less than 200 and number of households between 200 and 400.

Feeder and distribution fill factors changed to 95% for household density classes.

Density	Data	Total
<=5	Sum of # Households	62,645
	Average of Loop Length	81,872.32
	Average of Loop $ per HH	2,432.43
	Average of Total Invstmnt/Ln	3,095.68
>2550	Sum of # Households	364,583
	Average of Loop Length	8,070.19
	Average of Loop $ per HH	198.98
	Average of Total Invstmnt/Ln	459.98
200 to 650	Sum of # Households	273,086
	Average of Loop Length	15,153.19
	Average of Loop $ per HH	356.31
	Average of Total Invstmnt/Ln	643.22
5 TO 200	Sum of # Households	372,988
	Average of Loop Length	28,234.15
	Average of Loop $ per HH	703.56
	Average of Total Invstmnt/Ln	1,056.02
650 to 850	Sum of # Households	109,294
	Average of Loop Length	12,680.94
	Average of Loop $ per HH	293.74
	Average of Total Invstmnt/Ln	564.94
850 to 2550	Sum of # Households	689,169
	Average of Loop Length	11,045.12
	Average of Loop $ per HH	294.19
	Average of Total Invstmnt/Ln	560.32

	ARMIS	DIRECT
Aggregate Support at $20=	$ 68,282,535	$ 24,726,938
Aggregate Support at $30=	$ 29,248,778	$ 11,528,045
Aggregate Support at $40=	$ 17,055,916	$ 5,589,620
Annual Benchmark Cost =	$ 423,895,583	$ 307,385,019
State Average Monthly Cost=	$ 18.87	$ 13.69

Fill Factor 95% for Cable Distribution and Feeder
BCM Cable Multipliers

Density	Data	Total
<=5	Average of Monthly Cost1	81.72
	Average of Monthly Cost2	59.26
>2550	Average of Monthly Cost1	12.14
	Average of Monthly Cost2	8.80
200 to 650	Average of Monthly Cost1	16.98
	Average of Monthly Cost2	12.31
5 TO 200	Average of Monthly Cost1	27.88
	Average of Monthly Cost2	20.21
650 to 850	Average of Monthly Cost1	14.91
	Average of Monthly Cost2	10.81
850 to 2550	Average of Monthly Cost1	14.79
	Average of Monthly Cost2	10.73

Density	Data	Total
<=5	Sum of # Households	62,645
	Average of Loop Length	81,872.32
	Average of Loop $ per HH	227.08
	Average of Total Invstmnt/Ln	890.34
>2550	Sum of # Households	364,583
	Average of Loop Length	8,070.19
	Average of Loop $ per HH	467.10
	Average of Total Invstmnt/Ln	728.11
200 to 650	Sum of # Households	273,086
	Average of Loop Length	15,153.19
	Average of Loop $ per HH	276.17
	Average of Total Invstmnt/Ln	563.08
5 TO 200	Sum of # Households	372,988
	Average of Loop Length	28,234.15
	Average of Loop $ per HH	278.30
	Average of Total Invstmnt/Ln	630.76
650 to 850	Sum of # Households	109,294
	Average of Loop Length	12,680.94
	Average of Loop $ per HH	301.88
	Average of Total Invstmnt/Ln	573.08
850 to 2550	Sum of # Households	689,169
	Average of Loop Length	11,045.12
	Average of Loop $ per HH	336.05
	Average of Total Invstmnt/Ln	602.18

Density	Data	Total
<=5	Average of Monthly Cost1	23.50
	Average of Monthly Cost2	17.04
>2550	Average of Monthly Cost1	19.22
	Average of Monthly Cost2	13.94
200 to 650	Average of Monthly Cost1	14.86
	Average of Monthly Cost2	10.78
5 TO 200	Average of Monthly Cost1	16.65
	Average of Monthly Cost2	12.07
650 to 850	Average of Monthly Cost1	15.13
	Average of Monthly Cost2	10.97
850 to 2550	Average of Monthly Cost1	15.90
	Average of Monthly Cost2	11.53

	ARMIS	DIRECT
Aggregate Support at $20=	$ 64,764,997	$ 36,759,502
Aggregate Support at $30=	$ 47,682,225	$ 27,483,209
Aggregate Support at $40=	$ 38,846,200	$ 21,762,983
Annual Benchmark Cost =	$ 369,714,694	$ 268,096,113
State Average Monthly Cost=	$ 16.46	$ 11.94

SLC and AFC per line costs changed to $250 and $500 respectively. SLC and AFC discounts 40% and 25% respectively.

Density	Data	Total
<=5	Sum of # Households	62,645
	Average of Loop Length	81,872.32
	Average of Loop $ per HH	4,303.10
	Average of Total Invstmnt/Ln	4,477.28
>2550	Sum of # Households	364,583
	Average of Loop Length	8,070.19
	Average of Loop $ per HH	198.98
	Average of Total Invstmnt/Ln	373.16
200 to 650	Sum of # Households	273,086
	Average of Loop Length	15,153.19
	Average of Loop $ per HH	356.31
	Average of Total Invstmnt/Ln	530.49
5 TO 200	Sum of # Households	372,988
	Average of Loop Length	28,234.15
	Average of Loop $ per HH	866.56
	Average of Total Invstmnt/Ln	1,040.74
650 to 850	Sum of # Households	109,294
	Average of Loop Length	12,680.94
	Average of Loop $ per HH	293.74
	Average of Total Invstmnt/Ln	467.92
850 to 2550	Sum of # Households	689,169
	Average of Loop Length	11,045.12
	Average of Loop $ per HH	294.19
	Average of Total Invstmnt/Ln	468.37

	ARMIS	DIRECT
Aggregate Support at $20=	$ 56,967,453	$ 26,662,874
Aggregate Support at $30=	$ 33,170,227	$ 15,768,466
Aggregate Support at $40=	$ 22,842,041	$ 10,356,266
Annual Benchmark Cost =	$ 374,065,108	$ 271,250,786
State Average Monthly Cost=	$ 16.65	$ 12.08

Per switch cost of $167
Moderate Cable Multipliers
95% Fill factors for feeder and distribution
95% Fill factors for electronics

Density	Data	Total
<=5	Average of Monthly Cost1	118.19
	Average of Monthly Cost2	85.70
>2550	Average of Monthly Cost1	9.85
	Average of Monthly Cost2	7.14
200 to 650	Average of Monthly Cost1	14.00
	Average of Monthly Cost2	10.15
5 TO 200	Average of Monthly Cost1	27.47
	Average of Monthly Cost2	19.92
650 to 850	Average of Monthly Cost1	12.35
	Average of Monthly Cost2	8.96
850 to 2550	Average of Monthly Cost1	12.36
	Average of Monthly Cost2	8.97

Density	Data	Total
<=5	Sum of # Households	62,645
	Average of Loop Length	81,872.32
	Average of Loop $ per HH	4,303.10
	Average of Total Invstmnt/Ln	4,477.28
>2550	Sum of # Households	364,583
	Average of Loop Length	8,070.19
	Average of Loop $ per HH	198.98
	Average of Total Invstmnt/Ln	373.16
200 to 650	Sum of # Households	273,086
	Average of Loop Length	15,153.19
	Average of Loop $ per HH	356.31
	Average of Total Invstmnt/Ln	530.49
5 TO 200	Sum of # Households	372,988
	Average of Loop Length	28,234.15
	Average of Loop $ per HH	866.56
	Average of Total Invstmnt/Ln	1,040.74
650 to 850	Sum of # Households	109,294
	Average of Loop Length	12,680.94
	Average of Loop $ per HH	293.74
	Average of Total Invstmnt/Ln	467.92
850 to 2550	Sum of # Households	689,169
	Average of Loop Length	11,045.12
	Average of Loop $ per HH	294.19
	Average of Total Invstmnt/Ln	468.37

	ARMIS	DIRECT
Aggregate Support at $20=	$ 63,696,334	$ 29,230,056
Aggregate Support at $30=	$ 36,307,269	$ 17,429,545
Aggregate Support at $40=	$ 25,193,258	$ 11,430,572
Annual Benchmark Cost =	$ 389,651,154	$ 282,552,902
State Average Monthly Cost=	$ 17.35	$ 12.58

$167 Per Line Switch
Moderate Cable Multipliers
Fill Factors 95% for Cable Feeder and Distribution
Fill Factors 95% for Electronics
96% Penetration Rate Adjustment

Density	Data	Total
<=5	Average of Monthly Cost1	123.11
	Average of Monthly Cost2	89.27
>2550	Average of Monthly Cost1	10.26
	Average of Monthly Cost2	7.44
200 to 650	Average of Monthly Cost1	14.59
	Average of Monthly Cost2	10.58
5 TO 200	Average of Monthly Cost1	28.62
	Average of Monthly Cost2	20.75
650 to 850	Average of Monthly Cost1	12.87
	Average of Monthly Cost2	9.33
850 to 2550	Average of Monthly Cost1	12.88
	Average of Monthly Cost2	9.34

Density	Data	Total
<=5	Sum of # Households	90,209
	Average of Loop Length	81,872.32
	Average of Loop $ per HH	4,029.29
	Average of Total Invstmnt/Ln	4,169.06
>2550	Sum of # Households	525,000
	Average of Loop Length	8,070.19
	Average of Loop $ per HH	205.76
	Average of Total Invstmnt/Ln	345.53
200 to 650	Sum of # Households	393,244
	Average of Loop Length	15,153.19
	Average of Loop $ per HH	408.25
	Average of Total Invstmnt/Ln	548.01
5 TO 200	Sum of # Households	537,103
	Average of Loop Length	28,234.15
	Average of Loop $ per HH	927.14
	Average of Total Invstmnt/Ln	1,066.90
650 to 850	Sum of # Households	157,383
	Average of Loop Length	12,680.94
	Average of Loop $ per HH	320.89
	Average of Total Invstmnt/Ln	460.66
850 to 2550	Sum of # Households	992,403
	Average of Loop Length	11,045.12
	Average of Loop $ per HH	304.78
	Average of Total Invstmnt/Ln	444.54

	ARMIS	DIRECT
Aggregate Support at $20=	$139,630,590	$ 71,742,659
Aggregate Support at $30=	$ 90,827,080	$ 47,909,859
Aggregate Support at $40=	$ 68,384,006	$ 34,569,924
Annual Benchmark Cost =	$588,718,406	$426,905,176
State Average Monthly Cost=	$ 18.20	$ 13.20

Business 1.44 Gross-up to caculate lines
Per line switch cost of 134

Density	Data	Total
<=5	Average of Monthly Cost1	110.05
	Average of Monthly Cost2	79.80
>2550	Average of Monthly Cost1	9.12
	Average of Monthly Cost2	6.61
200 to 650	Average of Monthly Cost1	14.47
	Average of Monthly Cost2	10.49
5 TO 200	Average of Monthly Cost1	28.16
	Average of Monthly Cost2	20.42
650 to 850	Average of Monthly Cost1	12.16
	Average of Monthly Cost2	8.82
850 to 2550	Average of Monthly Cost1	11.73
	Average of Monthly Cost2	8.51

Density	Data	Total
<=5	Sum of # Households	62,645
	Average of Loop Length	81,872.32
	Average of Loop $ per HH	6,165.65
	Average of Total Invstmnt/Ln	6,305.42
>2550	Sum of # Households	364,583
	Average of Loop Length	8,070.19
	Average of Loop $ per HH	198.98
	Average of Total Invstmnt/Ln	338.74
200 to 650	Sum of # Households	273,086
	Average of Loop Length	15,153.19
	Average of Loop $ per HH	356.31
	Average of Total Invstmnt/Ln	496.07
5 TO 200	Sum of # Households	372,988
	Average of Loop Length	28,234.15
	Average of Loop $ per HH	1,004.50
	Average of Total Invstmnt/Ln	1,144.26
650 to 850	Sum of # Households	109,294
	Average of Loop Length	12,680.94
	Average of Loop $ per HH	293.74
	Average of Total Invstmnt/Ln	433.50
850 to 2550	Sum of # Households	689,169
	Average of Loop Length	11,045.12
	Average of Loop $ per HH	294.19
	Average of Total Invstmnt/Ln	433.95

	ARMIS	DIRECT
Aggregate Support at $20=	$ 67,103,359	$ 35,487,833
Aggregate Support at $30=	$ 45,417,522	$ 24,351,745
Aggregate Support at $40=	$ 34,718,330	$ 18,493,088
Annual Benchmark Cost =	$ 367,829,304	$ 266,728,935
State Average Monthly Cost=	$ 16.38	$ 11.88

Per line switch cost of $134
New cable multipliers
Fill Factors of 95% for Cable Feeder and Distribution
Fill Factor of 95% for Electronics

Density	Data	Total
<=5	Average of Monthly Cost1	166.44
	Average of Monthly Cost2	120.70
>2550	Average of Monthly Cost1	8.94
	Average of Monthly Cost2	6.48
200 to 650	Average of Monthly Cost1	13.09
	Average of Monthly Cost2	9.50
5 TO 200	Average of Monthly Cost1	30.21
	Average of Monthly Cost2	21.90
650 to 850	Average of Monthly Cost1	11.44
	Average of Monthly Cost2	8.30
850 to 2550	Average of Monthly Cost1	11.46
	Average of Monthly Cost2	8.31

Appendix 8C — COST COMPARISON OF COPPER/FIBER CROSSOVER POINT AT THE CBG LEVEL

Comparison of Annual BCM "Grand Total Loop Cost" and "Copper Grand Total Loop Cost" for CBGs of Various Total Distribution Distance Ranges

Total Distribution Range	Washington State Input Row	CBG #	Total Feeder and Distribution Distance	BCM "Grand Total Loop Cost"	Copper "Grand Total Loop Cost"	Savings	Percentage
12,000	Row 1790	530419717004	12,194	$ 179,329	$ 101,895	$ 77,434	43%
	Row 2224	530319503003	12,397	$ 131,017	$ 86,374	$ 44,643	34%
	Row 4366	530419715002	12,420	$ 317,565	$ 179,482	$ 138,083	43%
	Row 585	530210208002	13,168	$ 314,366	$ 201,236	$ 113,130	36%
	Row 1372	530050108021	13,585	$ 250,767	$ 169,915	$ 80,852	32%
							36%
15,000	Row 88	530330323044	14,697	$ 319,653	$ 214,172	$ 105,481	33%
	Row 661	530770029004	14,967	$ 197,368	$ 117,832	$ 79,536	40%
	Row 795	530530732001	15,166	$ 180,747	$ 105,966	$ 74,780	41%
	Row 1769	530259810001	15,608	$ 196,476	$ 115,747	$ 80,729	41%
	Row 4533	530670124004	14,445	$ 641,958	$ 320,025	$ 321,933	50%
							43%
18,000	Row 159	530579524004	18,934	$ 675,216	$ 403,346	$ 271,870	40%
	Row 646	530730104025	17,038	$ 627,656	$ 423,457	$ 204,199	33%
	Row 732	530139602002	17,371	$ 324,223	$ 225,049	$ 99,174	31%
	Row 733	530139602003	18,679	$ 405,735	$ 279,071	$ 126,664	31%
	Row 735	530579508002	18,354	$ 444,905	$ 314,466	$ 130,439	29%
							31%
21,000	Row 40	530579508004	21,255	$ 421,244	$ 336,983	$ 84,261	20%
	Row 161	530730104024	21,781	$ 421,506	$ 328,053	$ 93,452	22%
	Row 207	530559606002	21,246	$ 238,479	$ 182,455	$ 56,024	23%
	Row 937	530330326002	21,323	$ 252,165	$ 168,198	$ 83,967	33%
	Row 1411	530379757001	20,288	$ 340,980	$ 272,100	$ 68,880	20%
							25%
24,000	Row 592	530579527003	24,361	$ 512,789	$ 414,764	$ 98,025	19%
	Row 958	530559603003	23,905	$ 410,359	$ 332,308	$ 78,051	19%
	Row 1610	530659512003	23,116	$ 123,913	$ 87,411	$ 36,502	29%
	Row 1643	530270006003	24,972	$ 294,223	$ 207,207	$ 87,016	30%
							24%
27,000	Row 46	530579501001	26,445	$ 281,691	$ 219,811	$ 61,880	22%
	Row 165	530459604001	27,270	$ 450,192	$ 351,763	$ 98,429	22%
	Row 590	530319503002	26,294	$ 283,271	$ 211,254	$ 72,017	25%
	Row 783	530259804001	26,084	$ 507,263	$ 365,991	$ 141,272	28%
							24%

9 THE RELATIONSHIP OF THE BCM TO STATE USF PROCEEDINGS

9.1 Analyses of USF issues at the state level are instructive to federal USF policy development

Some have questioned whether the effort involved in fine tuning the BCM is worthwhile.[197] One important advantage to spending the up-front effort to develop an accurate and administratively simple cost proxy model is that it could serve as a tool for up to fifty-one jurisdictions that are required to ensure affordable access to telecommunications in rural, insular, and high-cost areas. As states have begun to grapple with the complex changes flowing from the decision to authorize local competition, many have identified universal service as a priority.

At the same time, PUCs have demonstrated a clear understanding that bloated universal service funding requirements, aimed at protecting LECs' existing revenues rather than the more narrow objective of protecting the availability of affordable service to high-cost areas, would run counter to the pro-competitive policies that they have committed to implement. A key concern is that accurate and verifiable cost data be furnished and reviewed before any universal service fund is implemented. In launching its universal service proceeding (still under way), the California PUC stated that "[c]ost studies are a good starting point for determining whether a subsidy is needed, how large the subsidy should be, and how the subsidy should be targeted."[198]

Reviewing and determining the validity of such cost studies have not proven to be a simple proposition. Several states have rejected the initial cost support preferred by

197. For example, the New York PSC, in its comments in Docket 80-286, suggested that the BCM was not worth the effort. It observed: "[w]e do not believe that the use of a proxy method provides any advantages that could not be accomplished through careful analysis of actual costs and state distribution flexibility." Comments of New York PSC, CC Docket No. 80-286, October 10, 1995, at 12.

198. California PUC, *Universal Service Proceeding*, Decision 95-07-050, July 19, 1995, at 83.

incumbent LECs in justification of large universal service funding requirements. In particular, consistent with observations that were made in the FCC's High Cost proceeding regarding the weakness of using reported costs, states have begun to identify serious problems in using the LECs' reported embedded cost studies as the basis for determining universal service requirements. In a recent decision, the Tennessee PSC found that "total service long run incremental cost studies may provide, in fact, the best information" and, accordingly, directed BellSouth to file such studies by the end of June 1996. Connecticut has required SNET to use TSLRIC studies as the basis for any universal service support proposal. Similarly, in Oregon, another state that has adopted a basic structure for universal service program, TSLRIC will also be used as the basis for determining whether service to a particular area requires a universal service subsidy.[199]

While TSLRIC costs are more appropriate for determining universal service funding requirements, there is still a problem in obtaining cost studies that are methodologically correct and verifiable. For example, the Connecticut DPUC rejected SNET's initial universal service proposal, stating that "[b]y providing deficient cost studies, SNET has failed to demonstrate that its costs for providing local service warrant further financial support. Therefore, without proper TSLRIC studies upon which to base a decision, the Department cannot offer a conclusion on this issue."[200]

State commissions that have reviewed this issue have also expressed general skepticism that the universal service "costs" that need to be supported are as extensive as those the LECs have represented. State regulators have expressly rejected the notion that universal service funding should make the LEC "whole" for loss of revenues associated with competitive entry. For example, in recommending competition rules for Ohio, the PUC Staff observed that "the Universal Service Fund is not a mechanism to recover unrecovered depreciation, "stranded" investment, or deferred expenses.[201] Recently, the Tennessee Public Service Commission stated that the definition of universal service "does not include any theoretical depreciation reserve deficiency that may represent a past carrier of last resort

199. See e.g., Tennessee PSC, *Universal Service Proceeding, op. cit.*, footnote 15, Initial Order, December 19, 1995; Connecticut DPUC, Docket No. 95-06-17 Decision, *op.cit.*, footnote 1; Oregon Public Service Commission, Docket No. UM-731, *In the Matter of Investigation of Universal Service in the State of Oregon*, Order No. 95-1103, October 17, 1995.

200. Connecticut DPUC, Docket 95-06-17 Decision, *op. cit.*, footnote 1, at 82.

201. Ohio PUC, Case No. 95-845-TP-COI, *In the Matter of the Commission Investigation Relative to the Establishment of Local Exchange Competition and Other Competitive Issues*, Entry, September 27, 1995, Appendix A (Staff's Recommendation), at 13.

obligation."[202] The Tennessee PSC also found that "[n]either does the definition require an acceleration of depreciation to upgrade existing technologies and facilities."[203]

In fact, there is growing interest in using methods that are not dependent upon reported embedded costs as the means for developing reliable cost support for universal service on a state-by-state basis. One approach is to determine universal service funding based upon price alone, without direct consideration of costs, by comparing *rates* (rather than costs) to an affordability benchmark.[204]

To preserve high cost as the relevant determinant of universal service support, while avoiding the inherent weaknesses of using reported, embedded costs, there is growing interest in using a cost proxy model like the BCM for determining state universal service funding requirements. State-specific results developed using either the unmodified BCM or variations of the BCM have been submitted for consideration in several states, including Pennsylvania and New York. Detailed analysis of two different cost proxy models is under way in a proceeding before the California PUC; that proceeding is discussed in detail below.

9.2 A Detailed Examination of the Cost Study Methodology and Universal Service Funding Issues under Investigation in California

California has been among the first states in the country to reexamine universal service issues in the context of emerging local exchange competition. On July 20, 1994, Governor Pete Wilson approved Assembly Bill No. 3643,[205] which directed the California PUC to open a universal service proceeding. The legislation set forth a number of specific objectives for the CPUC's investigation, including:[206]

- Define the goals for universal service in light of the new technologies and increasing competition in the local exchange marketplace, and develop a process to update the definition of universal service as the local exchange market continues to evolve;

202. Connecticut DPUC, Docket 95-06-17 Decision, *op. cit.*, footnote 1.

203. *Id.*, at 3.

204. See Chapter 7.

205. AB 3643 Polanco, Chapter 278, Stats. 1994.

206. *Id.*

- Determine the amount of subsidy support that may be required to ensure universal service, and devise a mechanism for its collection;

- Address the treatment of carrier of last resort (COLR) and franchise obligations in the evolving local exchange market.

Consequently, in January 1995, the CPUC initiated an investigation and rulemaking proceeding, I.95-01-021/R.95-01-020, to address these issues.[207] An initial round of comments was solicited in March 1995, which resulted in filings by eighteen interested parties including the major and independent LECs, consumer advocate organizations, and the California Telecommunications Coalition (hereafter, "Coalition") consisting of AT&T, MCI, a group of large business telecommunications users, the consumer advocacy group known as Toward Utility Rate Normalization (TURN), the California Cable Television Association, Teleport Communications Group, Time Warner AxS, and others.[208] On the basis of this input, the CPUC issued a decision in July 1995 setting forth draft rules to define universal service and to implement a mechanism to ensure its preservation in California.[209] The most important features of the draft rules are that the CPUC would:

- Undertake to develop and implement a competitively neutral universal service funding mechanism by January 1, 1997;[210]

- Define basic residential service for universal service purposes in terms of 16 discrete capabilities, including flat or measured rate service, touch tone dialing, and access to directory and operator services;[211]

- Obligate all LECs and new entrants ("competitive local carriers" or CLCs) to pursue the objective of attaining 95% penetration of telephone service among low-income and non-English speaking households in their operating areas;[212]

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207. California PUC, Universal Service Proceeding, Order Instituting Investigation and Rulemaking, January 24, 1995.

208. Subsequently, a number of consumer protection and advocacy organizations in California formed the Universal Service Alliance, which has also participated in the universal service proceeding. See *Telecommunications Reports*, June 12, 1996, at 42.

209. California PUC, Universal Service Proceeding, Decision 95-07-050, July 19, 1995.

210. *Id.*, Appendix A, "Proposed Universal Service Rules," Proposed Rule 3.B.1.

211. *Id.*, Proposed Rule 4.B.

212. *Id.*, Proposed Rule 3.B.3.a.

- Replace the existing California High Cost Fund (CHCF) revenue pooling mechanism with a High Cost Voucher Fund administered by the CPUC, which would collect funds from all service providers on a percentage of revenues basis (net of access payments), and distribute them to designated carriers of last resort (COLRs) on the basis of customers served in high cost areas as measured by proxy cost studies;[213]

- Require the major incumbent LECs to develop proxy costs using a total service long run incremental cost (TSLRIC) approach, in which the costs of providing basic universal service in individual geographic serving areas would be estimated on the basis of key cost drivers such as population density and average loop length;[214]

- Designate incumbent LECs as the COLR in their respective service territories, but allow new entrants to petition to become a COLR, and undertake a competitive bidding process to assign a COLR when no carrier is willing to serve as COLR at the existing subsidy level.[215]

In addition, a parallel CPUC decision that adopted interim rules for local exchange competition also created certain service obligations for new entrants.[216] Specifically, the interim competition rules require CLCs to serve all customers within their defined service areas who request service.

After issuing the proposed rules, the CPUC conducted ten hearings across the state in September and October 1995 to obtain public comment. In recent months, however, the CPUC has focused on the issue of devising an acceptable proxy cost model to quantify the aggregate costs of providing universal service in California and the amount of subsidy, if any, that may be required. The CPUC began this phase in December 1995 by considering the suitability of the version of the Benchmark Cost Model filed in FCC CC Docket 80-286. However, some members of the Coalition responded by presenting an updated version of the model that included further enhancements added by one of the original model designers, Hatfield Associates Inc. This version of the BCM (referred to as the "Hatfield model") remains under consideration by the CPUC.

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213. *Id.*, Proposed Rules 6.A-F.

214. *Id.*, Proposed Rule 6.A.

215. *Id.*, Proposed Rule 6.D-E.

216. California PUC, Consolidated R.95-04-043 and I.95-04-044, Order Instituting Rulemaking and Investigation on the Commission's Own Motion into Competition for Local Exchange Service, Decision 95-07-054, July 24, 1995, at 28.

In addition, however, on February 2, 1996, Pacific Bell presented to the CPUC the initial version of its Cost Proxy Model (CPM), which the Company intends to use to determine the costs of providing universal service in California. Pacific Bell has also suggested that the CPM could be adapted for use in the FCC's universal service proceeding,[217] but has not yet filed a version of the CPM with the FCC for that purpose. The CPM has been developed jointly by Pacific Bell and the consulting firm of INDETEC International. INDETEC has been chiefly responsible for development of the CPM software, while Pacific Bell has provided most of the user-modifiable assumptions and inputs. These two basic facets of the CPM are discussed separately below.

CPM software and costing algorithms

The Cost Proxy Model has been implemented using SAS (Statistical Analysis System) software, and is designed to be run on a personal computer with a Pentium processor and the Windows NT or Windows 95 operating system.[218] Similar to the BCM, the CPM software consists of a user interface, data tables, network engineering and costing algorithms, and output report generation capabilities. While the overall design of the user interface, data tables, and output reports have been relatively uncontroversial, the costing algorithms that represent the heart of the CPM have been subject to close scrutiny by the Coalition,[219] and may require further revision or explanation before the CPM is suitable to be used for estimating the costs of universal service. The following is a brief review of the most important costing algorithms in the CPM.

The CPM develops the incremental cost of providing local exchange service using a bottoms-up, engineering-based approach. The CPM takes as a starting point the *existing locations* of central offices[220], serving area interfaces (SAIs),[221] and residential

217. *Ex parte* submission in CC Docket No. 80-286 by Gina Harrison, Director, Federal Regulatory Relations, Pacific Telesis Group, February 29, 1996.

218. California PUC, Universal Service Proceeding, Pacific Bell/INDETEC International, Cost Proxy Model Documentation, Design Overview, at 2 (version dated February 3, 1996).

219. Economics and Technology, Inc. has been examining the CPM on behalf of AT&T, a Coalition member.

220. The BCM similarly works off of existing central office locations.

221. The *Serving Area Interface* (SAI) is the location where feeder cables are cross-connected to the distribution cables that serve up to several hundred customers, typically located within 1,000 to 3,000 feet of the SAI. Not all local loops transit an SAI, however. Unlike the CPM, the BCM does not incorporate SAIs into its theoretical network.

subscribers.[222] This data is used to calculate hypothetical local loop lengths for each residential customer contained in the database, with the length separately identified for the feeder (central office to SAI) and the distribution (SAI to customer premises) portions of each customer's local loop.[223]

Specifically, the CPM translates the airline distances calculated for each feeder and distribution route section, based upon ratios of airline-to-actual distances derived from a sampling of actual loops.[224] This implies that the individual loop lengths calculated by the CPM may vary significantly from those of in-place facilities, but that in the aggregate the model is constrained to existing, rather than optimized, routing patterns for local distribution plant.[225] After the feeder and distribution cable lengths have been determined for the customer, the investment costs for the required feeder and distribution plant are calculated using average cable sizes and broad-gauge estimates of cable, support structure, and installation costs. The average cable sizes and plant cost estimates were generally developed from Pacific Bell-specific embedded data, and are disaggregated by population density (seven classes measured with respect to wire centers), technology type (copper vs. fiber feeder), and plant type (underground, buried,[226] aerial).[227] Separate plant cost estimates were made for costs incurred on a per-foot basis, e.g. the costs of cable sheath, supporting structure, and installation, and costs incurred on a wire-pair basis, such as cable materials and splicing costs.[228]

A key assumption of CPM is the application of a uniform 9,000 foot threshold for choosing between copper and fiber facilities in the feeder plant.[229] For all feeder routes extending less than 9,000 feet, CPM assumes the use of copper cables, without digital loop

222. Unlike the CPM's Pacific Bell-only version (which reflects the actual location of customers), the BCM assumes a uniform distribution of households. See Chapter 6, above.

223. As explained below, Pacific Bell's later "statewide" version of the CPM does not directly calculate loop lengths from customer locations.

224. California PUC, Universal Service Proceeding, Pacific Bell, Presentation by W.L. Vowell, Universal Service Workshop, February 2, 1996, at slide 2.

225. By contrast, the BCM optimizes such routing.

226. The BCM classifies plant as either underground or aerial, and does not include "buried" cable in a separate category.

227. See, e.g., *op. cit.*, footnote 222, at slides 8, 25, 26.

228. See, e.g., *op. cit.*, footnote 222, at slide 10.

229. See, e.g., *op. cit.*, footnote 222, at slides 6-7.

carrier (DLC) facilities. For feeder routes longer than 9,000 feet, the CPM develops costs based upon fiber cable and DLC equipment.

While Pacific Bell claims that the assumption of a 9,000 foot threshold is consistent with the Company's current engineering practice, it is not immediately clear why the relative cost-effectiveness of the copper and fiber alternatives should not also vary depending upon other important cost drivers such as demand along the route and population density. That is, it may well be less expensive to deploy fiber rather than copper feeder plant along routes of considerably less than 9,000 foot length in the highest density urban areas, where there would be sufficient demand to absorb the higher fixed costs of the fiber and pair gain equipment. Conversely, the CPM may overstate the costs of feeder in lower density rural areas, where copper feeder may in fact be more cost-effective than feeder even at distances exceeding 9,000 feet.

Moreover, Pacific Bell has not shown that the 9,000-foot threshold assumption is consistent with the feeder plant cost estimates used in the CPM. At a minimum, the Company needs to demonstrate that the CPM correctly chooses the least-cost alternative for feeder plant based upon its own assumptions. Unfortunately, the use of dummy cost values in certain key areas (e.g., pair gain investment costs) of the CPM version made available for review has prevented independent analysts from making such an evaluation to date.

A second issue is that the CPM fails to differentiate between the network facilities required to furnish a *single subscriber access line to each residential household* — which is the scope of the universal service mandate defined by the CPUC — and the additional network facilities that the Company deploys in order to provide *second line* and other ancillary exchange services. For example, the CPM sizes distribution plant under an assumption of two pairs per unit,[230] which from the standpoint of universal service alone represents an unreasonable amount of excess and idle plant capacity. Furthermore, the problem is compounded by the fact that the upstream network components, e.g., the Remote Terminal systems used with fiber feeder, are themselves sized in CPM to accommodate the inflated number of distribution pairs that results. Some, but not necessarily all, of these effects may be remedied by adjusting the CPM's plant utilization factors, but the issue needs to be more thoroughly investigated in order for the CPM to be validated. See Chapter 6, above, for a more detailed discussion of this point.

The costing algorithms used in the CPM are likely to receive close scrutiny in California, and the model may evolve considerably over the course of that proceeding. Whether the CPM could serve as a vehicle for providing reasonable estimates of universal service costs at a national level remains to be seen, however.

230. California PUC, Universal Service Proceeding, Deposition of William L. Vowell (Pacific CPM witness), March 11, 1996, at 142.

User-modifiable assumptions and inputs

Complementary to the CPM software are the user-modifiable assumptions and inputs, including such data as central office and customer locations (latitude and longitude), geographic variables (e.g., density, terrain, and soil type), and unitized network component costs (e.g., investment cost per foot of aerial copper distribution cable).[231] The initial version of the CPM that was presented to the CPUC was designed to model Pacific Bell's costs only, and virtually all of the inputs, including the customer location database and network component costs, were specific to the Company.

In March 1996, Pacific Bell filed a second version of the CPM that produces statewide average costs, as well as local service costs for each LEC operating in California. This version contains significant changes from the Pacific Bell-only model, including the use of several alternative data sources. Most importantly, the statewide version of the CPM replaces Pacific Bell's proprietary database of customer locations with a commercial database that maps population and other demographic information to latitude and longitude.[232] Since the commercial database does not provide discrete customer locations, the CPM's developers were forced to make a series of assumptions to convert the population data into line counts and loop lengths that can be applied as inputs to the CPM.[233] Therefore, use of the commercial database has reduced the CPM's dependency upon proprietary, unreviewable data sources, but it has also weakened the model's apparent realism relative to the BCM in calculating loop lengths.

231. The use of "unitized" costs presupposes that such costs are linear, which in fact may not be the case. Thus, the unit cost of a quantity of central office processor capacity depends fundamentally upon the aggregate level of utilization of the switch, because much of the processor cost is fixed over a broad range of output. Use of unitized costs has the effect of both concealing the presence of economies of scale and of spreading such economies of scale uniformly across all utilization. Where utilization should be service-dependent (as in the case of outside plant working fill), this approach may inappropriately shift costs of spare capacity away from potentially competitive and discretionary services and onto core basic primary residential access lines.

232. California PUC, Universal Service Proceeding, Pacific Bell and INDETEC International, CPM — California Universal Service Subsidy, at 1.

233. *Id.*

10 CORRECTING THE SHORTCOMINGS OF THE BENCHMARK COST MODEL

10.1 Recommendations regarding the use of the BCM in USF policy deliberations

In the preceding chapters of this report, we:

- Described the criteria by which one should evaluate any cost proxy model;
- Summarized the BCM's essential algorithms, assumptions, and cost data;
- Identified specific flaws and shortcomings in the BCM, and suggested ways to remedy those deficiencies;
- Suggested a framework for the consideration of the revenues that are relevant to any universal service funding determination;
- Computed partially corrected data for (1) the cost of basic residential local exchange service and (2) the level of universal service support required; and
- Discussed some of the salient aspects of several state universal service proceedings that relate to the use of the BCM.

We have identified many key aspects of the model that should be modified and, where feasible, we have suggested either specific corrections or a detailed framework by which corrections can be made. However, although the BCM needs to be changed in some fundamental ways, these corrections are all "doable" and, indeed, if these modifications are incorporated, the BCM can serve as a valuable tool for policy makers as they meet the challenge of creating a workable, effective, and competitively neutral universal service support mechanism. The BCM should thus serve as the foundation for a comprehensive cost proxy model and, if the corrections that are identified in this report are made, it should be adopted as a policy making tool.

Our analysis also demonstrates that claims of universal service requirements are typically inflated. Even the results of the uncorrected BCM demonstrate that universal service support typically is needed only in sparsely populated parts of the country, and that for most parts of the nation no funding or support is needed at all. As Appendix 7A demonstrates, present high cost funds of approximately $750-million, in combination with the existing income-based Lifeline, Link Up, and TRS programs, provide targeted support. There is absolutely no reason for expanding universal service support more broadly.

10.2 Summary of the effects of the ETI corrections to the BCM

In some instances we have corrected individual flaws in the BCM in isolation by revising the input data and rerunning the model. In other cases, we have run the model with several simultaneous changes. In the following discussion, we summarize the effect of some of these corrections. Summary tabulations produced by the BCM for some of the many ETI runs are included in Appendix 8B.

As is described in Chapter 3, the statewide average cost for residential local exchange service in Washington State, as computed by the uncorrected BCM, is $16.94. In Chapter 5, we demonstrated that the switch cost data are flawed. The result of correcting the cost data for switches is to *lower* the average monthly cost by approximately *$2.50.*

In Chapter 6, we identified the flaw in the BCM concerning the extremely low fill factors that are assumed in the outside plant. The low fill factors (ranging between 25% and 75% in the distribution plant, and between 65% and 80% in the feeder plant) are indicative of network engineering associated with volatile, unpredictable demand for services other than the primary residential access line. A cost proxy model that is being used for assessing universal service requirements should instead reflect substantially higher fill factors to reflect the fact that demand for single-line residential local exchange service is stable and highly predictable. Therefore, we corrected the flawed BCM fill factors and related structure cost multipliers: The result of making this correction in isolation is to *lower* the average monthly cost by approximately *$2.50.* Furthermore, the costs and discounts for digital loop carrier (DLC) subscriber equipment that the BCM assumes are excessive, in part because they fail to reflect large discounts that are routinely offered by vendors. However, because of the difficulty in obtaining more accurate price data, we conducted a sensitivity analysis based upon cost information developed by Hatfield Associates for use in the California USF proceeding. The result of changing these data (and making no other corrections to the BCM) is to *lower* the average monthly cost by approximately *$5.00.*

Not all households subscribe to local exchange service. However, a network design intended to accommodate the universal service goal must *assume* 100% penetration.

Accordingly, we incorporated a revision to adjust for the actual subscribership rate of 96.0% in Washington State. This correction *raises* the average monthly cost by approximately *$0.40.*

The BCM incorporates an uneconomic decision as to when to deploy fiber in the feeder plant. We analyzed the implications of changing the crossover point from the default value of 12,000 feet to various alternative distances ranging between 9,000 feet and 27,000 feet. Increasing the distance at which the crossover decision is made decreases the average cost, confirming our belief that the BCM's fiber/copper decision rule is not economically based.[234] For example, increasing the distance to 27,000 feet lowered the average cost by approximately *$2.00*[235]

These corrections are interrelated, so their combined effect must be determined through the model itself rather than by a mere aggregation. As discussed in Chapter 8, ETI ran the BCM with corrected switch costs, revised fill factors for outside plant, and an adjustment for the subscribership rate. The result of these changes - *expressed on a national basis* — is to *lower* the average monthly cost by approximately *$4.34,* i.e., the ETI corrected result is a monthly average cost of $12.37. There are also significant corrections whose effect we were not able to quantify that should nevertheless be addressed. These changes will significantly affect the average cost as determined by the BCM (and in almost all instances *reduce* it), and correspondingly decrease the overall universal service funding requirement:

- As is shown by our sensitivity analysis, the assumptions about the costs and discounts for digital loop equipment substantially influence the cost of basic local exchange service. Our partially corrected final numbers reflect the BCM's unsupported and likely excessive costs for digital loop equipment. The use of more realistic cost data would significantly *lower* the final results.

- Correcting the over-simplified assumption of uniform household density with the road buffer approach that the Joint Sponsors have identified will further *lower* the cost.

- The fiber/copper crossover point, if corrected to reflect engineering economic cost evaluations (rather than being based upon considerations other than the provision of primary residential access lines), would result in *lower* costs.

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234. LECs may be motivated to expand fiber deployment for strategic reasons, such as their desire to acquire a digital-capable network. However, for purposes of estimating the costs of primary residential access lines, the efficient crossover point for a voice-only network should be used. From our analysis, it would appear that this is considerably greater than the 12,000 feet assumed by the model.

235. As we explain in Chapter 6, reducing the digital loop equipment costs to reflect vendor discounts will likely affect both the crossover distance itself as well as the ultimate magnitude of this correction.

- The deployment of wireless service in those high-cost areas where the costs of wireless are less than those for wireline service would *lower* the average cost.

- The stand-alone cost of single-line basic residential service and the stand-alone cost of all other local exchange services should be computed, so that the benefit of the economies can be shared with universal service. This would *lower* the average cost.

- The BCM should be revised to include the costs of service area interfaces (SAIs), which would *increase* the average cost by less than $0.50.[236]

Based upon our comprehensive analyses of the BCM, we conclude that the average national monthly cost for basic residential local exchange service is less than $12.50 per month. Also, once corrected costs are computed for each CBG, reflecting the corrections identified above, the BCM should then assess the need (if any) for universal service support by evaluating such need on a wire center basis. Because the BCM does not, in its present form, readily permit such an evaluation, we have not yet quantified the effect of this correction to the model. However, such a correction will clearly *lower* the universal service funding requirement.

Correcting the switch costs and the fill factors lowers the national universal service requirement computed by the BCM from approximately the range $1.4- to $4.0-billion range[237] to a range of $400-million to $1.5-billion.

10.3 The use of the BCM in policy making proceedings

As presented by the Joint Sponsors, the BCM overstates — and by a significant amount — the costs incident to the universal and ubiquitous provision by LECs of primary residential access lines. As such, the BCM cannot be used in its present form unless the various logical and factual assumptions and data upon which it is based are addressed and corrected. The design of the BCM is, however, sufficiently flexible so as to accommodate all of the specific corrections that we have identified. With these modifications, the revised BCM can satisfy the need for a comprehensive cost proxy model that will be capable of informing the complex universal service policy issues currently before state and federal regulators.

236. California PUC, *Universal Service Proceeding*, Pacific Bell and INDETEC International, CPM — California Universal Service Subsidy, at 5.

237. These data assume Cost Factor No. 2.

CERTIFICATE OF SERVICE

I, Staci M. Pittman, do hereby certify that on this 12th day of April, 1996, copies of the foregoing **"Comments of the National Cable Television Association, Inc."** were delivered by first-class, postage pre-paid mail upon the attached list:

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